

WHAT IS CLAIMED IS:

- 1 1. An immersion lithographic system comprising:
2 an optical surface;
3 a wafer support for holding a workpiece; and
4 an immersion fluid with a pH less than 7, disposed between the optical surface and the
5 wafer support, said immersion fluid contacting at least a portion of the optical surface.
- 1 2. The system of claim 1 wherein the immersion fluid comprises water.
- 1 3. The system of claim 2 wherein the pH of said immersion fluid is in the range of 2 to 7.
- 1 4. The system of claim 3 wherein the pH of said immersion fluid is in the range of 4 to 7.
- 1 5. The system of claim 4 wherein the pH of said immersion fluid is in the range of 5 to 7.
- 1 6. The system of claim 5 wherein the pH of said immersion fluid is in the range of 6 to 7.
- 1 7. The system of claim 1 wherein the immersion fluid comprises hydrogen ions with a
2 concentration in the range of 10^{-7} to 10^{-2} mole/L.
- 1 8. The system of claim 1 wherein the immersion fluid comprises hydrogen ions with a
2 concentration in the range of 10^{-7} to 10^{-4} mole/L.
- 1 9. The system of claim 1 wherein the immersion fluid comprises hydrogen ions with a
2 concentration in the range of 10^{-7} to 10^{-5} mole/L.

- 1 10. The system of claim 1 wherein the immersion fluid comprises hydrogen ions with a
2 concentration in the range of 10^{-7} to 10^{-6} mole/L.
- 1 11. The system of claim 1 wherein the optical surface comprises silicon oxide.
- 1 12. The system of claim 1 wherein the optical surface comprises fused silica.
- 1 13. The system of claim 1 wherein the optical surface comprises calcium fluoride.
- 1 14. The system of claim 13 further comprising a fluoride-containing compound dissolved in
2 the immersion fluid.
- 1 15. The system of claim 14 wherein the fluoride containing compound comprises at least one
2 material selected from the group consisting of sodium fluoride, potassium fluoride, hydrogen
3 fluoride, and combinations thereof.
- 1 16. The system of claim 13 wherein the immersion fluid comprises fluoride ions with a
2 concentration in the range of greater than 0.01 mole/L.
- 1 17. The system of claim 16 wherein the immersion fluid comprises fluoride ions with a
2 concentration in the range of greater than 0.05 mole/L.
- 1 18. The system of claim 17 wherein the immersion fluid comprises fluoride ions with a
2 concentration in the range of greater than 0.1 mole/L.
- 1 19. The system of claim 1 further comprising a semiconductor structure on the wafer support
2 structure, said semiconductor structure having a topmost photosensitive layer.

- 1 20. The system of claim 19 wherein the photosensitive layer comprises a chemically
2 amplified photoresist.
- 1 21. The system of claim 19 wherein the immersion fluid is in contact with a portion of the
2 photosensitive layer.
- 1 22. The system of claim 19 wherein the semiconductor structure is immersed in the
2 immersion fluid.
- 1 23. The system of claim 19 wherein the semiconductor structure comprises an integrated
2 circuit that includes transistors with a gate length not greater than 50 nm.
- 1 24. The system of claim 19 wherein the wafer support is immersed in the immersion fluid.
- 1 25. An immersion lithographic system for projecting light having a wavelength of less than
2 197 nm, the system comprising:
3 an optical surface;
4 water with a pH less than 7, said water contacting at least a portion of the optical surface;
5 and
6 a semiconductor structure having a topmost photoresist layer, a portion of said
7 photoresist being in contact with the water.
- 1 26. The system of claim 25 wherein the pH of the water is in the range of 2 to 7.
- 1 27. The system of claim 26 wherein the pH of the water is in the range of 5 to 7.

- 1 28. The system of claim 27 wherein the pH of the water is in the range of 6 to 7.
- 1 29. The system of claim 25 wherein the optical surface comprises silicon oxide.
- 1 30. The system of claim 25 wherein the optical surface comprises calcium fluoride.
- 1 31. The system of claim 25 further comprising a fluoride containing compound dissolved in
2 the water.
- 1 32. The system of claim 31 wherein the fluoride containing compound comprises at least one
2 material selected from the group consisting of sodium fluoride, potassium fluoride, hydrogen
3 fluoride, and combinations thereof.
- 1 33. The system of claim 25 wherein the water comprises fluoride ions with a concentration in
2 the range of greater than 0.01 mole/L.
- 1 34. The system of claim 25 wherein the photoresist layer comprises a chemically amplified
2 photoresist.
- 1 35. The system of claim 25 wherein the semiconductor structure is immersed in the water.
- 1 36. The system of claim 25 further comprising a wafer support underlying the semiconductor
2 structure.
- 1 37. The system of claim 36 wherein the wafer support is immersed in the water.

1 38. A method for illuminating a semiconductor structure having a topmost photoresist layer,
2 comprising the steps of:
3 introducing an immersion fluid into a space between an optical surface and the
4 photoresist layer, said immersion fluid having a pH of less than 7; and
5 directing optical energy through the immersion fluid and onto said photoresist layer.

1 39. The method of claim 38 wherein the immersion fluid comprises water.

1 40. The method of claim 38 wherein the pH of the immersion fluid is in the range of 2 to 7.

1 41. The method of claim 40 wherein the pH of the immersion fluid is in the range of 4 to 7.

1 42. The method of claim 41 wherein the pH of the immersion fluid is in the range of 5 to 7.

1 43. The method of claim 42 wherein the pH of the immersion fluid is in the range of 6 to 7.

1 44. The method of claim 38 wherein the immersion fluid comprises hydrogen ions with a
2 concentration in the range of 10^{-7} to 10^{-2} mole/L.

1 45. The method of claim 44 wherein the immersion fluid comprises hydrogen ions with a
2 concentration in the range of 10^{-7} to 10^{-4} mole/L.

1 46. The method of claim 45 wherein the immersion fluid comprises hydrogen ions with a
2 concentration in the range of 10^{-7} to 10^{-5} mole/L.

1 47. The method of claim 46 wherein the immersion fluid comprises hydrogen ions with a
2 concentration in the range of 10^{-7} to 10^{-6} mole/L.

- 1 48. The method of claim 38 wherein the optical surface comprises silicon oxide.
- 1 49. The method of claim 38 wherein the optical surface comprises calcium fluoride.
- 1 50. The method of claim 49 wherein the immersion fluid comprises water.
- 1 51. The method of claim 50 further comprising a fluoride containing compound dissolved in
2 the water.
- 1 52. The method of claim 51 wherein the fluoride containing compound comprises a
2 compound selected from the group consisting of sodium fluoride, potassium fluoride, hydrogen
3 fluoride, or combinations thereof.
- 1 53. The method of claim 49 wherein the immersion fluid comprises fluoride ions with a
2 concentration in the range of greater than 0.01 mole/L.
- 1 54. The method of claim 49 wherein the immersion fluid comprises fluoride ions with a
2 concentration in the range of greater than 0.05 mole/L.
- 1 55. The method of claim 49 wherein the immersion fluid comprises fluoride ions with a
2 concentration in the range of greater than 0.1 mole/L.
- 1 56. The method of claim 38 wherein the photoresist layer comprises a chemically amplified
2 photoresist.
- 1 57. The method of claim 38 wherein the immersion fluid is in contact with a portion of the
2 photoresist layer.

- 1 58. The method of claim 38 wherein the semiconductor structure is immersed in the
2 immersion fluid.
- 1 59. The method of claim 38 further comprising a wafer support underlying the semiconductor
2 structure.
- 1 60. The method of claim 59 wherein the wafer support is immersed in the immersion fluid.
- 1 61. The method of claim 38 further comprising a step of developing the photoresist layer.
- 1 62. The method of claim 61 wherein the step of developing the photoresist layer comprises
2 immersing the photoresist in a tetramethylammonia hydroxide solution.
- 1 63. A method for illuminating a semiconductor structure having a topmost photoresist layer,
2 comprising the steps of:
3 introducing water into a space between an optical surface and the photoresist layer said
4 water having a pH of less than 7; and
5 directing light with a wavelength of less than 450 nm through the water and onto said
6 photoresist.
- 1 64. The method of claim 63 wherein the pH of the water is in the range of 2 to 7.
- 1 65. The method of claim 64 wherein the pH of the water is in the range of 5 to 7.
- 1 66. The method of claim 65 wherein the pH of the water is in the range of 6 to 7.
- 1 67. The method of claim 63 wherein the optical surface comprises silicon oxide.

- 1 68. The method of claim 63 wherein the optical surface comprises calcium fluoride.
- 1 69. The method of claim 63 further comprising a fluoride containing compound dissolved in
2 the water.
- 1 70. The method of claim 69 wherein the fluoride containing compound comprises a
2 compound selected from the group consisting of sodium fluoride, potassium fluoride, hydrogen
3 fluoride, and combinations thereof.
- 1 71. The method of claim 63 wherein the water comprises fluoride ions with a concentration
2 in the range of greater than 0.01 mole/L.
- 1 72. The method of claim 63 wherein the photoresist layer comprises a chemically amplified
2 photoresist.
- 1 73. The method of claim 63 wherein the semiconductor structure is immersed in the water.
- 1 74. The method of claim 63 further comprising a wafer support underlying the semiconductor
2 structure.
- 1 75. The method of claim 74 wherein the wafer support is immersed in the water.